CLAIMS:

1. An optical communications apparatus for power balancing a wavelength division multiplexed (WDM) signal output from an add module adding at least one channel to a signal input thereto, comprising:

a gain element optically coupled to the add module and to an add channel port receiving at least channel to be added;

said gain element imparting optical gain to the at least one channel received from the add channel port;

a controller operatively coupled to said gain element,

said controller receiving an input power measurement of the signal input to the add module;

said controller determining an add path amplification value based on the input power measurement, a through loss associated with a signal passing through the add module, and an add loss associated with a signal travelling an add path of the add module; and

said controller controlling said gain element according to the add path amplification value.

2. The optical communications apparatus for power balancing a wavelength division multiplexed (WDM) signal according to claim 1,

said controller receiving a number of channels to be added by the add module;

said controller determining the add path amplification value based on the number of channels to be added, the input power measurement, the through loss associated with a signal

passing through the add module, and the add loss associated with a signal travelling an add path of the add module; and

said controller controlling said gain element according to the add path amplification value.

3. The optical communications apparatus for power balancing a wavelength division multiplexed (WDM) signal according to claim 2,

said controller determining the add path amplification value based on the following equation:

$P_{addtotal} = P_{in} + (\text{Add Loss} - \text{Through Loss}) + 10 \text{Log} N_{add}$

where

$P_{addtotal}$ = add path amplified power level in dBm,

P_{in} = per channel power level of signal input to the add module in dBm,

Through Loss = loss associated with a signal passing through the add module in dBm,

Add Loss = loss associated with a signal travelling an add path of the add module in dBm, and

N_{add} = number of added channels.

4. The optical communications apparatus for power balancing a wavelength division multiplexed (WDM) signal according to claim 1, further comprising:

a coupler optically coupled to an input of the add module,

an optical-to-electrical converter optically coupled to said coupler, said optical to-electrical coupler receiving a portion of light from the input signal input to the add module;

said controller determining the input power measurement from an output of said optical-to-electrical converter.

5. The optical communications apparatus for power balancing a wavelength division multiplexed (WDM) signal according to claim 1,

said controller receiving an added channel power measurement of the least one added channel being added by the add module;

said controller feedback controlling said gain element based on the added channel power measurement and the add path amplification value.

6. The optical communications apparatus for power balancing a wavelength division multiplexed (WDM) signal according to claim 1,

said gain element having a gain profile substantially matching a gain profile of a signal input to the add module.

7. The optical communications apparatus for power balancing a wavelength division multiplexed (WDM) signal according to claim 1, further comprising:

an input amplifier optically coupled an input port of the add module and receiving a plurality of input channels;

said gain element having a gain profile substantially matching a gain profile of said input amplifier.

8. The optical communications apparatus for power balancing a wavelength division multiplexed (WDM) signal according to claim 1, further comprising:

an output amplifier optically coupled to the add module;

said output amplifier amplifying the output of the add module.

9. The optical communications apparatus for power balancing a wavelength division multiplexed (WDM) signal according to claim 8,

said output amplifier performing gain flattening amplification for the signal output from the add module.

10. The optical communications apparatus for power balancing a wavelength division multiplexed (WDM) signal according to claim 1,

wherein said gain element includes an add amplifier,

said controller controlling said add amplifier according to the add path amplification value.

11. The optical communications apparatus for power balancing a wavelength division multiplexed (WDM) signal according to claim 1,

wherein said gain element includes an add amplifier and a variable optical attenuator,

said controller controlling said variable optical attenuator according to the add path amplification value.

12. The optical communications apparatus for power balancing a wavelength division multiplexed (WDM) signal according to claim 1,

wherein said gain element includes an add amplifier and a variable optical attenuator,

said controller controlling said variable optical attenuator and said add amplifier according to the add path amplification value.

13. The optical communications apparatus for power balancing a wavelength division multiplexed (WDM) signal according to claim 1,

wherein the add module is an add/drop module not dropping any channels.

14. A method of power balancing a wavelength division multiplexed (WDM) signal output from an add module adding at least one channel to a signal input thereto, comprising:

receiving an input power measurement of the signal input to the add module;

determining an add path amplification value based on the input power measurement, a through loss associated with a signal passing through the add module, and an add loss associated with a signal travelling an add path of the add module; and

controlling an add path amplification of the add path according to the add path amplification value.

15. The method according to claim 14, further comprising:

receiving a number of channels to be added by the add module; and

determining the add path amplification value based on the number of channels to be added, the input power measurement, the through loss associated with a signal passing through the add module, and the add loss associated with a signal travelling an add path of the add module.

16. The method according to claim 15, further comprising:

determining the add path amplification based on the following equation:

$P_{addtotal} = P_{in} + (\text{Add Loss} - \text{Through Loss}) + 10\text{Log}N_{add}$

where

$P_{addtotal}$ = add path amplified power level in dBm,

P_{in} = per channel power level of the signal input to the add module in dBm,

Through Loss = loss associated with a signal passing through the add module in dBm,

Add Loss = loss associated with a signal travelling an add path of the add module in dBm, and

N_{add} = number of added channels.

17. The method according to claim 14, further comprising:

substantially matching a gain profile of the add path with a gain profile of a signal input to the add module.

18. The method according to claim 14, further comprising:

preamplifying a signal input to the add module;

said preamplification step imparting a gain profile substantially similar to a gain profile of the add path.

19. The method according to claim 14,

wherein the add path includes an add amplifier;

said controlling step controlling a gain of the add amplifier.

20. The method according to claim 14,

wherein the add path includes an add amplifier and a variable optical attenuator optically coupled thereto;

said controlling step controlling a gain of the add amplifier and/or an attenuation of the variable optical attenuator.

21. The method according to claim 14,

amplifying the output of the add module.

22. The method according to claim 21,

said amplifying the output step including gain-flattening amplification.

23. The method according to claim 14, wherein the add module is an add/drop module that is not currently dropping a channel.